Smoke and Fire Detection

Generally recognized paucity of data to guide fire detection in spacecraft.

Team focused on Issues and Concerns and Research Areas

Reviewed correlation between Issues and Concerns and related Research areas

Condensed research areas to 3 major areas and 3 minor areas

Dichotomy between the physical factors and human factors

(Human factors given less consideration largely due to group experience)

Large number of near term/concurrent issues

Smoke and Fire Detection
Issues and Concerns

1. Nuisance Alarms.
2. Visibility.
3. Will it detect a fire?
4. How should the crew respond, how will it respond?
5. Knowledge is incomplete.
6. Will current systems work?
7. Is detection quick enough?
8. No indication of danger level from sensors.
9. No information on partial-g smoke and fire signatures.
10. Where do we put the detectors?
11. What should we detect?
12. How does the crew know where the fire is?
13. What are the risks outside of the crew cabin?
14. Post-fire sensing (toxicity & corrosion).

Smoke and Fire Detection Research Areas

1. **What are we looking for?**
   - Target and high risk fire definitions? — Near Term
   - Fire signatures — Near Term
   - Threshold settings,background levels
   - What aren't we looking for?
2. **When and how do we respond?**
   - Levels of response/automation
   - Nuisance levels (impact on human response) — Near Term
   - Human Factors
3. **How do we design and place detectors?**
   - Technology/modality — Near Term
   - Air flow in modules — Near Term
   - Automation
   - Sampling
   - Integration into ISS
   - Requirements
   - Risk Assessment
   - Annunciation technique

Smoke and Fire Detection Research Areas (continued)

4. What post-fire detection is needed?

5. Uninhabited regions

6. Partial-G

Smoke and Fire Detection
Enabling Technologies

Small, robust, diverse, sensitive and specific sensors

Distributed intelligence systems

Smoke and Fire Detection
Conclusions (1)

General agreement that current detection systems are based upon inadequate knowledge.

Current systems are well intended based on current knowledge but are unverified for the 0-g environment.

Risk of nuisance alarms is significant. Current detectors are susceptible to dust. Given limited crew time, this could be a serious problem.

Poor track record detecting small transients, with no data, cannot predict performance with larger events.

Smoke and Fire Detection
Conclusions (2)

Detection in large cabin volumes and standoffs is a serious concern.

Further improvements in detection will require implementation of hybrid detection systems (probably species and particles).

Other ignition sources beyond electrical sources must receive further consideration: spontaneous ignition is a potential risk and detection in waste systems may not be adequate.